which it is attached, and which necessarily limits the precision of which it is capable.

The author next gives the results of some experiments with a collimator made for Captain Foster, having a float of only 5 inches in diameter, and with a telescope 5 inches long; the errors generally do not amount to more than $\frac{2}{10}$ths of a second.

He then enters into details as to the manner of using the vertical floating collimator in astronomical observations, beginning with the portable azimuth and altitude circle, described by the Rev. F. Wollaston in his *Fasciculus Astronomicus*, and applicable to other similar instruments. The new collimator affords also the most perfect method of adjusting the line of collimation of a mural circle or of placing it at right angles to the axis.

The author next proceeds to describe the method of applying the instrument to the zenith telescope. In comparing the observations made by the zenith sector, belonging to the Board of Ordnance, with the zenith telescope used in conjunction with the vertical floating collimator, the mean of errors in the former case was $+0''{\cdot}54$ and $-0''{\cdot}75$; in the latter $+0''{\cdot}44$ and $-0''{\cdot}66$. From observations made on γ Draconis, the zenith distance of which at Greenwich is $0°\ 2'\ 6''{\cdot}36$, and at York Gate $0°\ 0'\ 35''{\cdot}67$; the difference of latitude between the two places was found to be $0°\ 2'\ 42''{\cdot}03$; that of Greenwich being $51°\ 28'\ 38''{\cdot}96$, and of York Gate $51°\ 31'\ 20''{\cdot}99$. The decimals of a second, by the azimuth and altitude circle and the horizontal floating collimator, were ·94; by the same instrument and the vertical floating collimator, ·76; and by the zenith telescope, and the vertical floating collimator, ·92: the mean being ·9.

From the greater degree of precision attainable by the employment of the vertical floating collimator, from the facility of its construction, the readiness of its application, and the time saved by using it, the author deems it not unreasonable to infer, that ere long, the use of the level and plumb-line in celestial observations will be wholly abandoned.

On the Height of the Aurora Borealis above the surface of the Earth; particularly one seen on the 29th of March, 1826. *By* John Dalton, *F.R.S.* Read April 17, 1828. [*Phil. Trans.* 1828, *p.* 291.]

The author observes that opinions differ as to the elevation of the Aurora Borealis above the surface of the earth, and that this is a point which can be determined only by a series of concurring observations. The appearance of a phenomenon of this kind on the 29th of March, 1826, assuming the form of a regular arch at right angles to the magnetic meridian, and marked by peculiar features, continuing for above an hour in the same position, afforded a most favourable opportunity for obtaining the data requisite for the solution of this problem; and the author accordingly took great pains to collect as many authentic accounts as possible of the apparent position of this luminous arch with reference to the stars, when seen

from various places where it had been observed in England and in Scotland. It appears to have been actually seen in places 170 miles distant from one another, in a north and south direction, and 45 miles distant from east to west, thus comprising an area of 7000 or 8000 square miles; but it must have been visible over a much greater extent. Accounts were received of its having been seen as far north as Edinburgh, and as far south as Manchester and Doncaster, and at most of the intermediate towns; and from the exact correspondence of the descriptions from all these places, it was impossible to doubt that they referred to the same luminous appearance. In proceeding from north to south, the apparent altitude of the arch continually increased, still keeping to the south of the zenith till we come to Kendal, at which place it very nearly crossed the zenith; at Warrington, which is further south, the culminating point of the arch was north of the zenith. Wherever seen, the arch always seemed to terminate nearly in the magnetic, east and west, at two opposite points of the horizon.

The observations, in which the author places the greatest confidence for determining the height of this aurora, were those made at Whitehaven and at Warrington, places which are distant 83 miles from one another, and situated nearly on the same magnetic meridian. Calculating from the data they afford, he finds the height of the arch very nearly 100 miles above the surface of the earth, and immediately over the towns of Kendal and of Kirkby-Stephen. This conclusion is corroborated by observations at Jedburgh; but if the former be compared with those at Edinburgh, the height will come out to be 150 or 160 miles, and the position vertical about Carlisle: but he thinks the former result more entitled to confidence. Assuming the height to be 100 miles, it will follow that the breadth of the arch would be 8 or 9 miles, and its visible length in an east and west direction from any one place would be about 550 miles. The author then proceeds to take a comparative view of the results of inquiries on the height and position of other auroræ which have at different times appeared, and are recorded in the Philosophical Transactions and other scientific journals. He also gives an account of a luminous arch seen both at Kendal and at Manchester on the 27th of December last, which appeared in the zenith at the former place, and was elevated 53° from the north at the latter place; whence its height is deduced to be 100 miles. From the general agreement of this series of observations, the author infers that these luminous arches of the aurora, which are occasionally seen stretching from east to west, are all nearly of the same height; namely, about 100 miles. Observations are still wanting for the determination of the length of beams parallel to the dipping-needle, which constitute the more ordinary forms of the aurora borealis; neither can it be determined whether these beams arise above the arches, as from a base, or whether they descend below, as if appended to the arches. It is remarkable that the arches and beams are rarely, if ever, seen connected together, or in

juxta-position; but always in parts of the heavens at a considerable distance from each other.

A Comparison of the Changes of Magnetic Intensity throughout the Day in the Dipping and Horizontal Needles, at Treurenburgh Bay in Spitsbergen. By Captain Henry Foster, *R.N. F.R.S.* Read May 8, 1828. [*Phil. Trans.* 1828, *p.* 303.]

The observations made by the author at Port Bowen in 1825, on the diurnal changes of magnetic intensity taking place in the dipping- and horizontal-needles, appeared to indicate a rotatory motion of the polarizing axis of the earth, depending on the relative position of the sun, as the cause of these changes. By Capt. Foster's remaining at Spitzbergen, during the late Northern Voyage of Discovery, a favourable opportunity was afforded him of prosecuting this inquiry. Instead of making observations with a single needle, variously suspended, as had been done at Port Bowen, two were employed,—the one adjusted as a dipping-needle, and the other suspended horizontally. The relation between the simultaneous intensities of the two needles could thus be ascertained, and inferences deduced relative to the question whether a diurnal variation in the dip existed as one of the causes of the observed phenomena, or whether, the dip remaining constant, they were occasioned by a change in the intensity.

The dipping-needle used was one belonging to the Board of Longitude, and made by Dollond. Both this and the horizontal-needle were made in the form of parallelopipedons, each 6 inches long, 0·4 broad, and 0·05 thick. The experiments were continued from the 30th of July to the 9th of August; and were so arranged, that in the course of two days an observation was made every hour in the four-and-twenty; that is, part of them in one day and another part in the other day.

The observations on the horizontal-needle were made in the following manner:—after being freely suspended by a silk thread divested of torsion, the needle was turned somewhat more than 40° out of the magnetic meridian, and the oscillations counted only when the arc of vibration had decreased to 40°. The times of performing ten oscillations were then noted successively until 200 were completed; the terminal arc and the temperature of the instrument were also registered. The oscillations of the dipping-needle were taken as follows: one hundred with the face of the instrument east, previous to those of the horizontal-needle being observed; and another hundred after the latter, with the face west,—a process which gives the mean time of observation nearly the same for both needles. Two tables are given; the first containing a register of the observations; and the second, the mean proportional intensities at every hour in each needle, deduced from the respective times of the performance of 100 oscillations. From a comparison of the changes occurring in